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University of Wisconsin - Madison

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Design and Management of a Multifaceted Fish Passage Improvement Project – The Mirabel Case Study

Jon Mann, PE

June 10, 2014

International Conference on Engineering and Ecohydrology for Fish Passage

Madison, WI

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01 Background and Concept Development

Location and Species

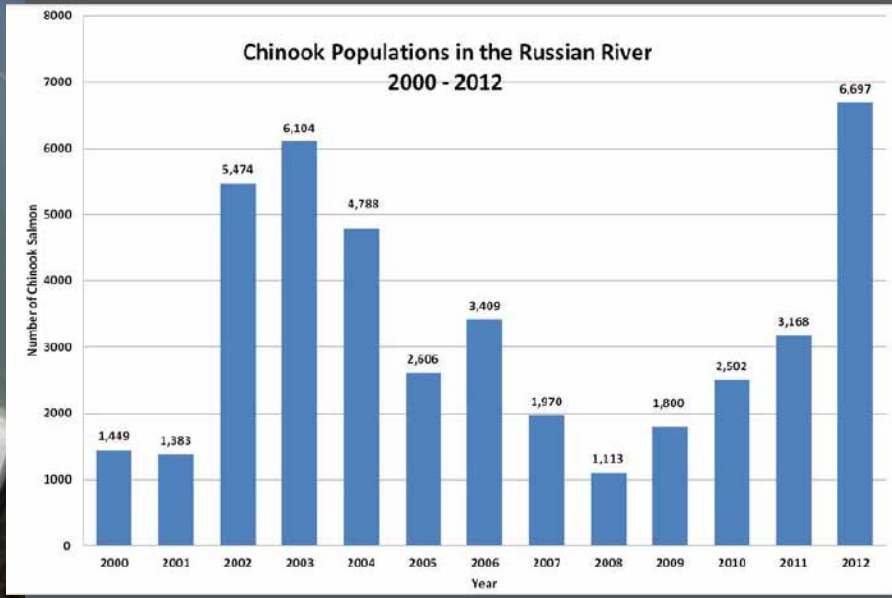
Russian River, Sonoma County, California

Coho Salmon – endangered

Chinook Salmon – threatened

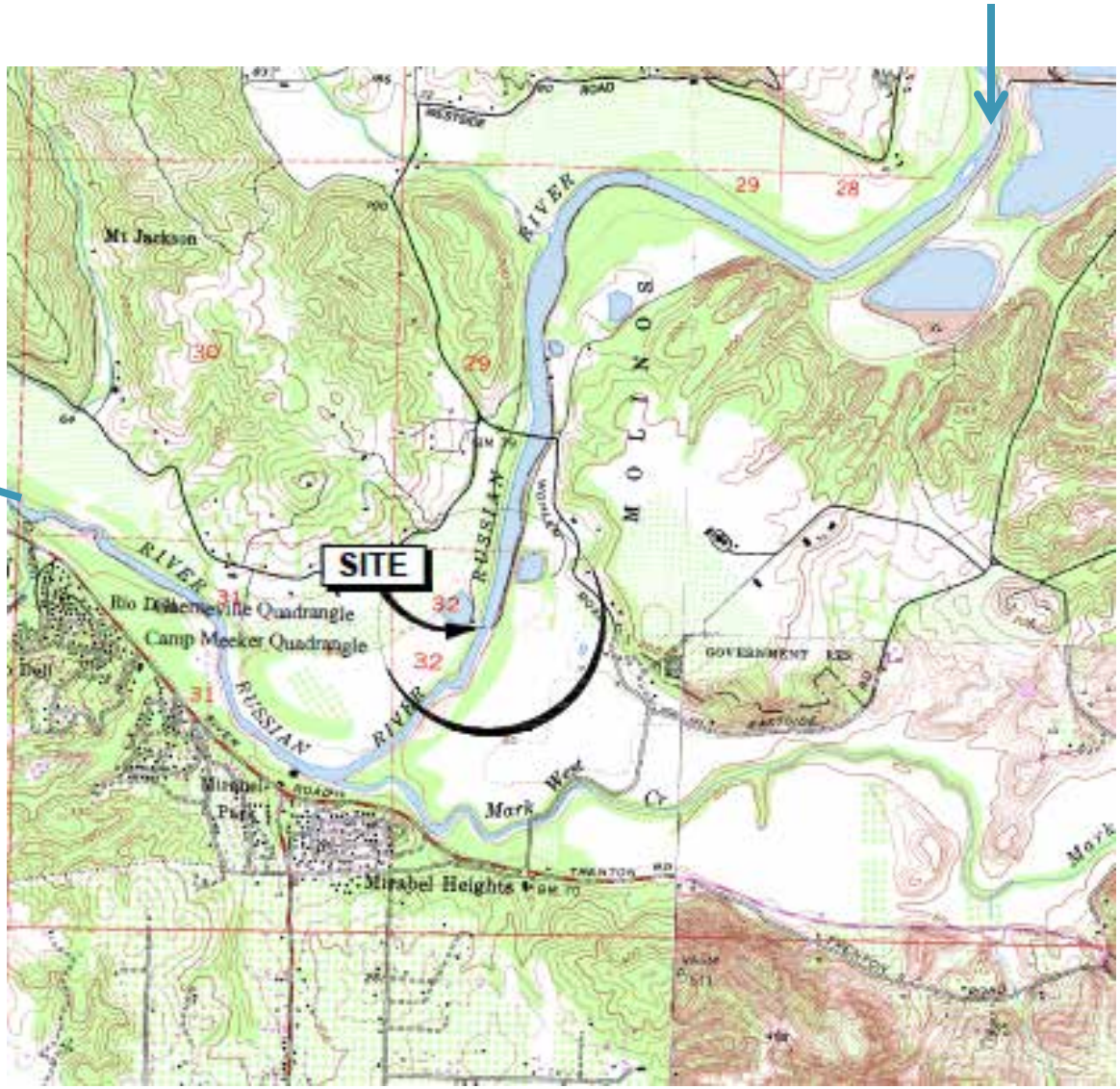
Steelhead – threatened

Pacific Lamprey - SOC



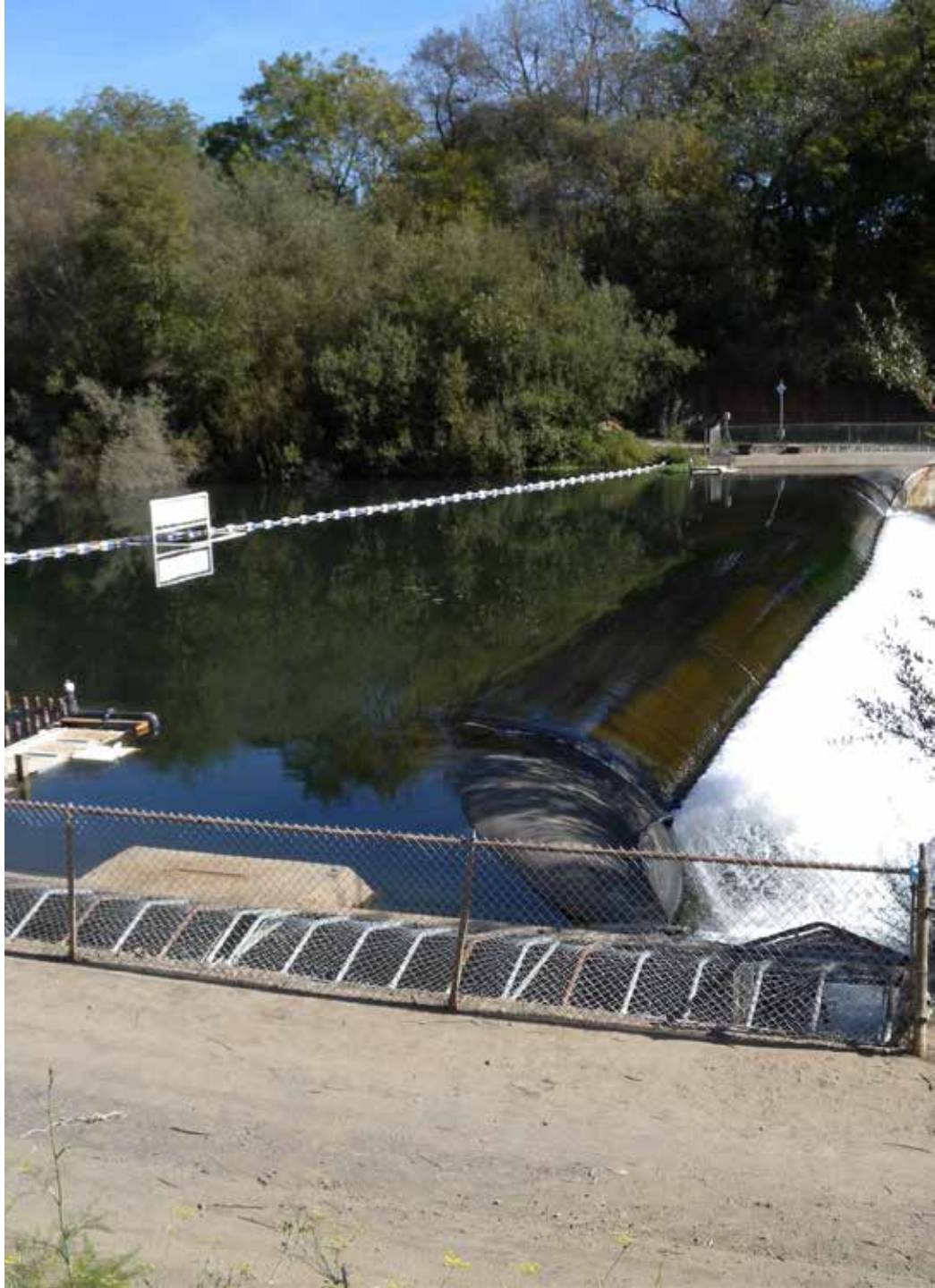
Location

Pacific Ocean



Basic Site Info

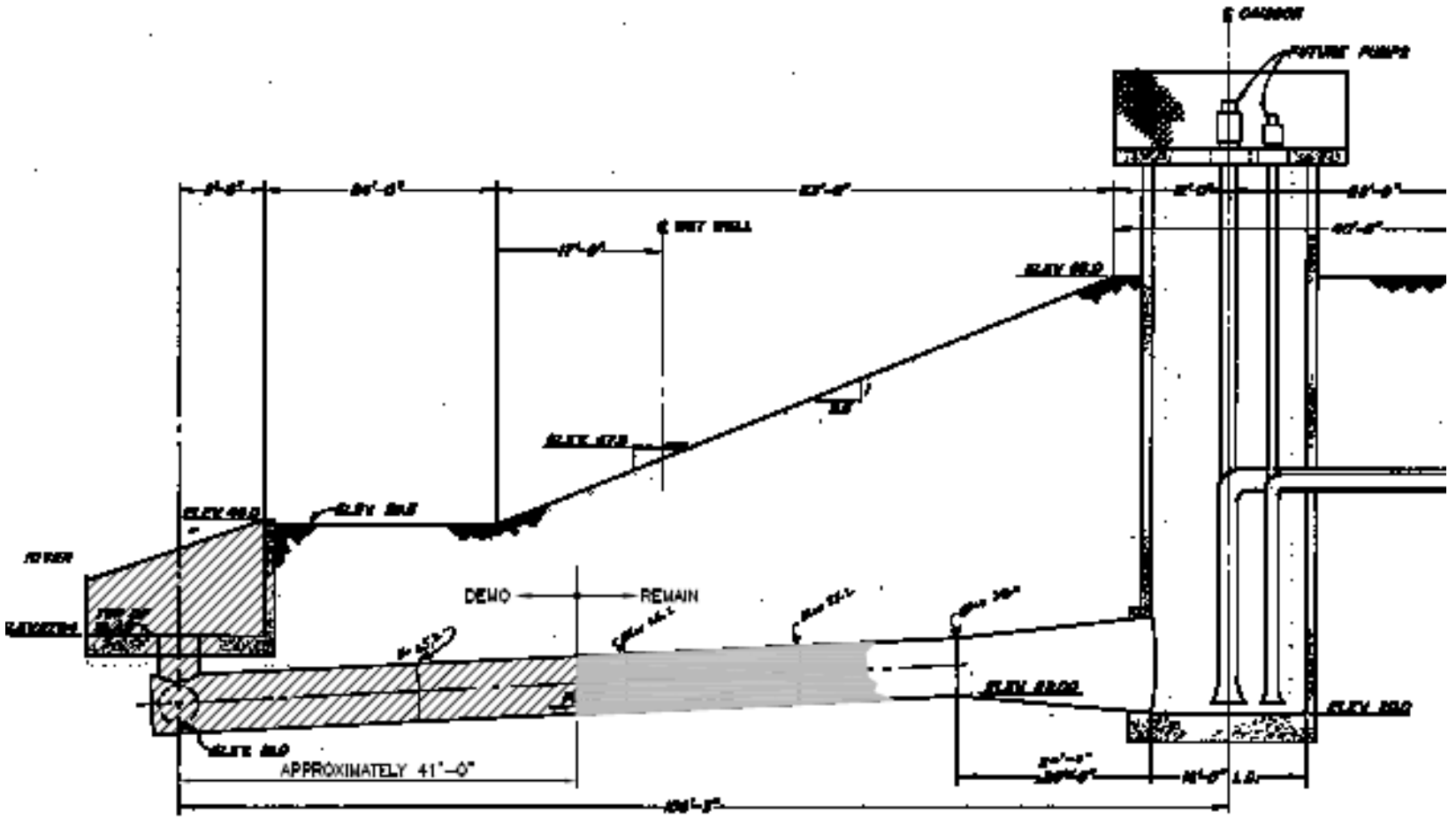
- ~11 ft high inflatable dam - 1976
- 100 cfs surface diversion to infiltration ponds
- Vertical-axis rotary drum screens
- Operated Spring through Fall
- 2 Denil type fishways around each dam abutment
- Biological Opinion – new fish screen
- Prior Studies –
  - Mirabel Fish Screen Performance Evaluation – 2000
  - Smolt Emigration Study – 2001 to 2004
  - Fish Screen Replacement Feasibility - 2009
- In final design since 2011




DIVERSION CAISSON
AND PUMP STATION
DEBRIS BOOM
INTAKE AREA WITH
DRUM SCREENS
BOAT PORTAGE
(THIS SIDE ONLY)
FISH LADDERS
INFLATABLE DAM
FLOW


01 01 2012

Existing Intake



Mirabel Dam Inflation

May 8-11, 2011


29.70 inHg
64°F
05/08/11 05:00 PM
MIRABEL


29.93 inHg
44°F
05/09/11 09:00 AM
MIRABEL


29.84 inHg
53˚F
05/09/11 11:00 AM
MIRABEL


29.70 inHg
61°F
05/09/11 01:00 PM
MIRABEL


29.70 inHg
65°F
05/09/11 03:00 PM
MIRABEL


29.64 inHg
69˚F
05/09/11 05:00 PM
MIRABEL


29.93 inHg
40˚F
05/10/11 07:00 AM
MIRABEL

29.93 inHg
46˚F
05/10/11 09:00 AM
MIRABEL

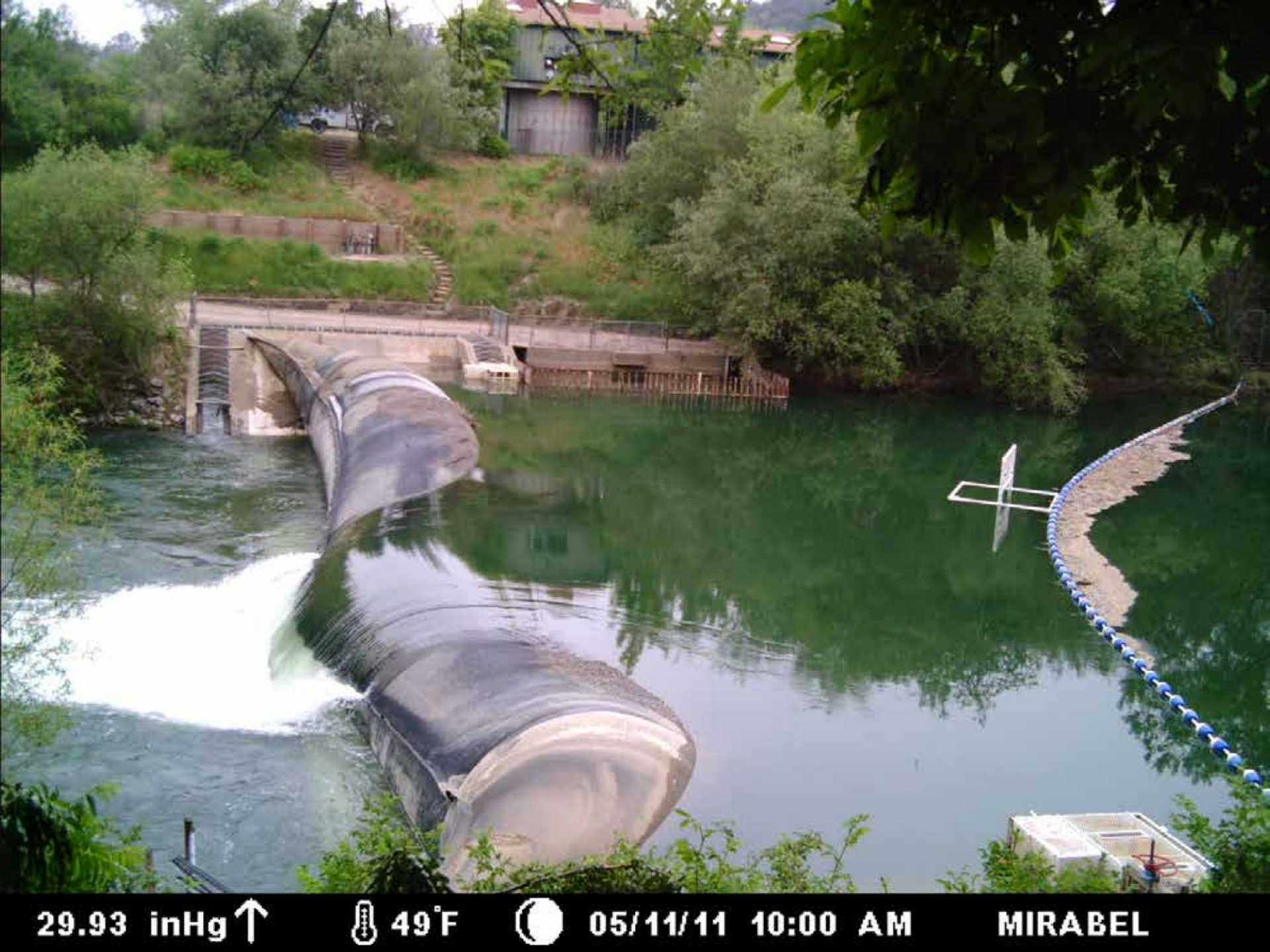

29.84 inHg
57°F
05/10/11 11:00 AM
MIRABEL


29.70 inHg
66˚F
05/10/11 01:00 PM
MIRABEL

29.56 inHg
71°F
05/10/11 03:00 PM
MIRABEL

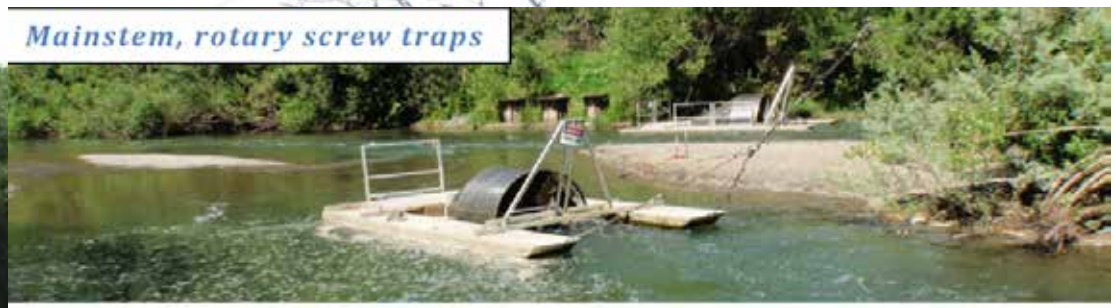

29.56 inHg
75°F
05/10/11 05:00 PM
MIRABEL

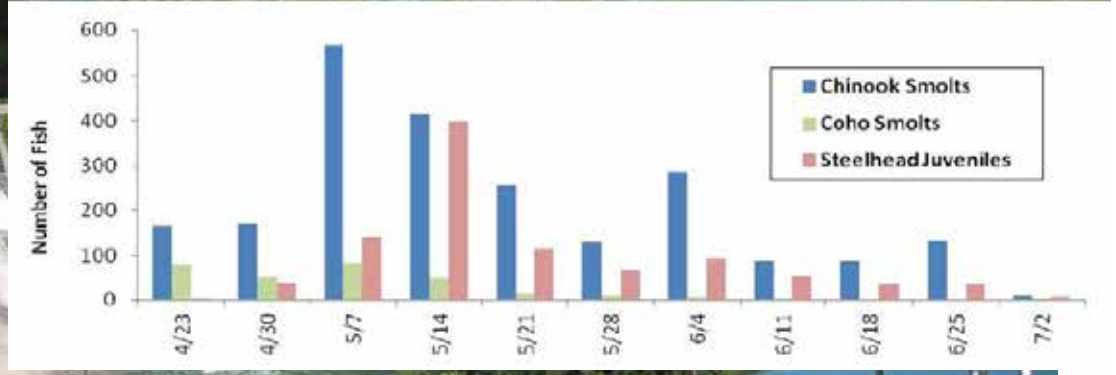

29.93 inHg
47˚F
05/11/11 08:00 AM
MIRABEL


29.93 inHg
49°F
05/11/11 10:00 AM
MIRABEL


Last
29.93 inHg
54˚F
05/11/11 12:00 PM
MIRABEL

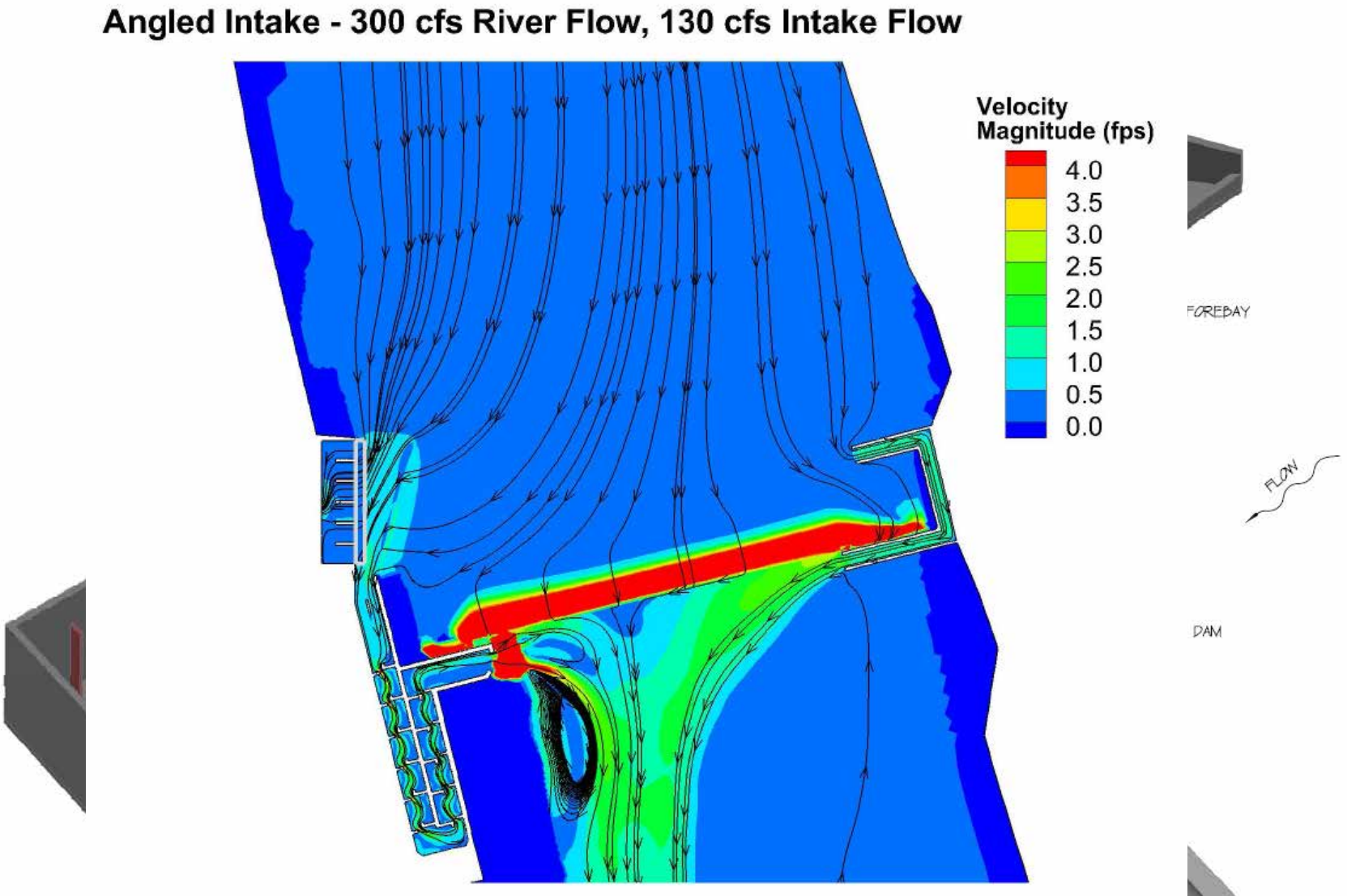
Smolt Emigration



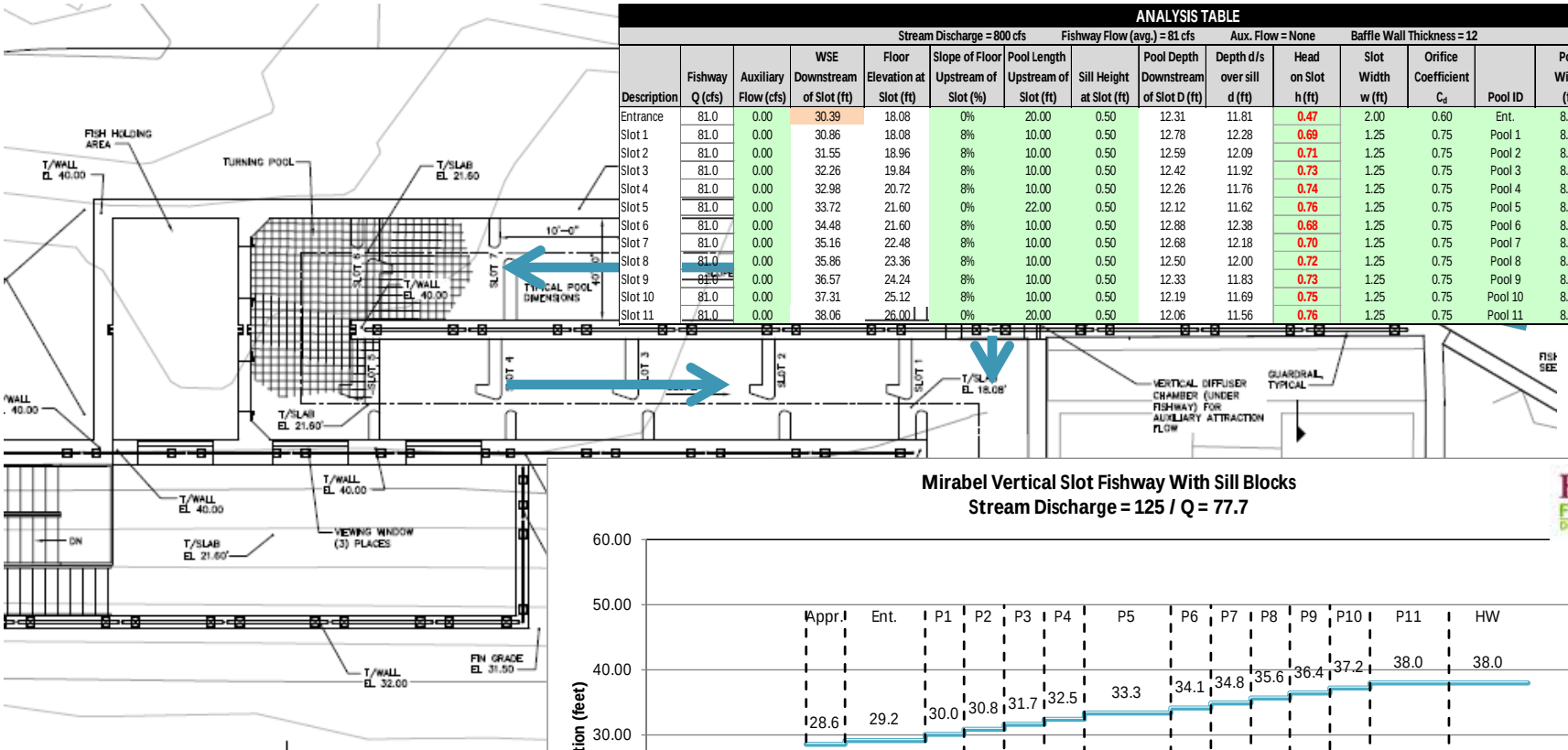


Notching dam to improve smolt emigration

Concept Design



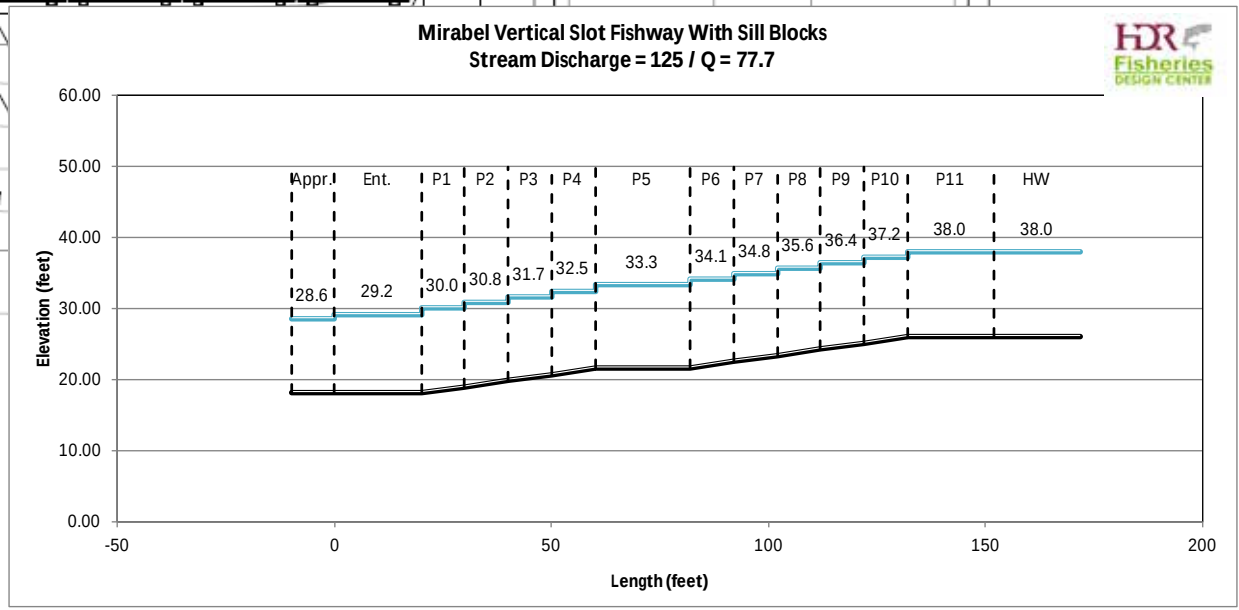
Concept Design – Bypass fishway



ANALYSIS TABLE

Stream Discharge = 800 cfs | Fishway Flow (avg.) = 81 cfs | Aux. Flow = None | Baffle Wall Thickness = 12

Description	Fishway Q (cfs)	Auxiliary Flow (cfs)	WSE Downstream of Slot (ft)	Floor Elevation at Slot (ft)	Slope of Floor Upstream of Slot (%)	Pool Length Upstream of Slot (ft)	Sill Height at Slot (ft)	Pool Depth Downstream of Slot D (ft)	Depth d/s over sill d (ft)	Head on Slot h (ft)	Slot Width w (ft)	Orifice Coefficient C_d	Pool ID	Pool Width (ft)	EDF (ft-lbs/cuft-s)
Entrance	81.0	0.00	30.39	18.08	0%	20.00	0.50	12.31	11.81	0.47	2.00	0.60	Ent.	8.00	1.159
Slot 1	81.0	0.00	30.86	18.08	8%	10.00	0.50	12.78	12.28	0.69	1.25	0.75	Pool 1	8.00	3.330
Slot 2	81.0	0.00	31.55	18.96	8%	10.00	0.50	12.59	12.09	0.71	1.25	0.75	Pool 2	8.00	3.466
Slot 3	81.0	0.00	32.26	19.84	8%	10.00	0.50	12.42	11.92	0.73	1.25	0.75	Pool 3	8.00	3.595
Slot 4	81.0	0.00	32.98	20.72	8%	10.00	0.50	12.26	11.76	0.74	1.25	0.75	Pool 4	8.00	3.716
Slot 5	81.0	0.00	33.72	21.60	0%	22.00	0.50	12.12	11.62	0.76	1.25	0.75	Pool 5	8.00	1.686
Slot 6	81.0	0.00	34.48	21.60	8%	10.00	0.50	12.88	12.38	0.68	1.25	0.75	Pool 6	8.00	3.262
Slot 7	81.0	0.00	35.16	22.48	8%	10.00	0.50	12.68	12.18	0.70	1.25	0.75	Pool 7	8.00	3.402
Slot 8	81.0	0.00	35.86	23.36	8%	10.00	0.50	12.50	12.00	0.72	1.25	0.75	Pool 8	8.00	3.534
Slot 9	81.0	0.00	36.57	24.24	8%	10.00	0.50	12.33	11.83	0.73	1.25	0.75	Pool 9	8.00	3.658
Slot 10	81.0	0.00	37.31	25.12	8%	10.00	0.50	12.19	11.69	0.75	1.25	0.75	Pool 10	8.00	3.775
Slot 11	81.0	0.00	38.06	26.00	0%	20.00	0.50	12.06	11.56	0.76	1.25	0.75	Pool 11	8.00	1.881

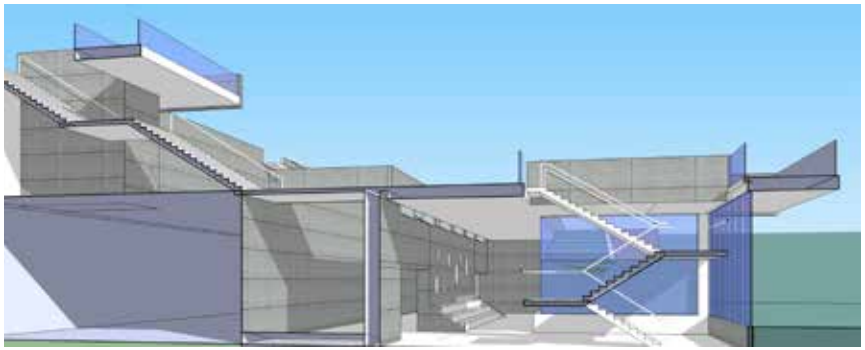


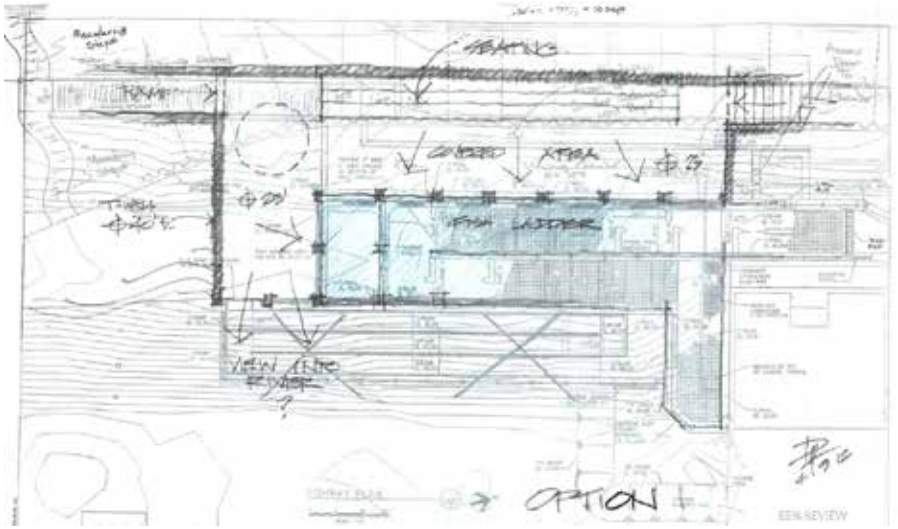
02 Viewing Gallery Design

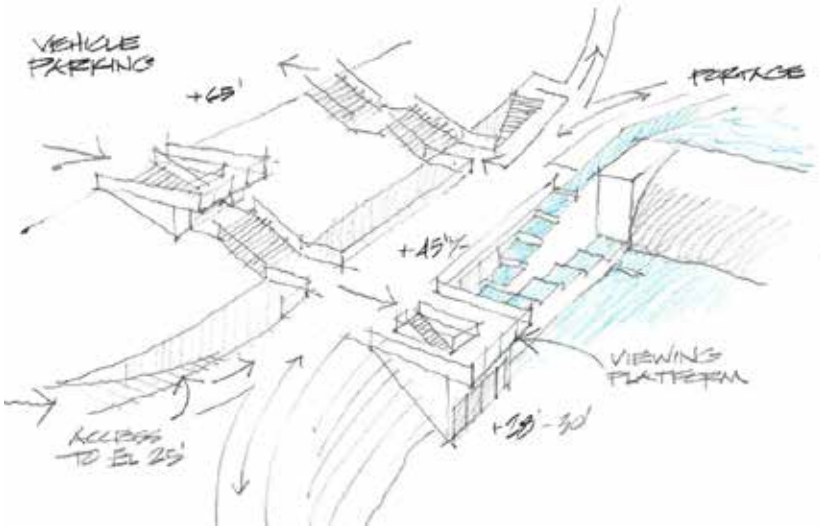
Viewing Chambers

Viewing Chambers

Viewing Chamber Design




OPTION


VEHICLE PARKING
+65'
+45'
VIEWING PLATFORM

Viewing Chamber Design

MIRABEL FISH SCREEN AND FISH LADDER REPLACEMENT
SONOMA COUNTY WATER AGENCY

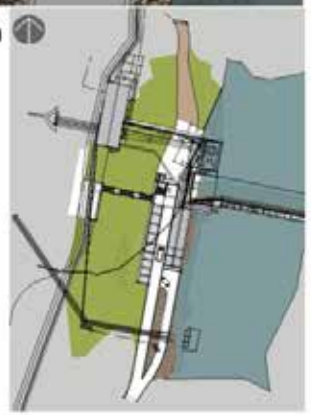
SCHEME 1B

HDR
ASMEC
DESIGN CENTER

Scheme 1B

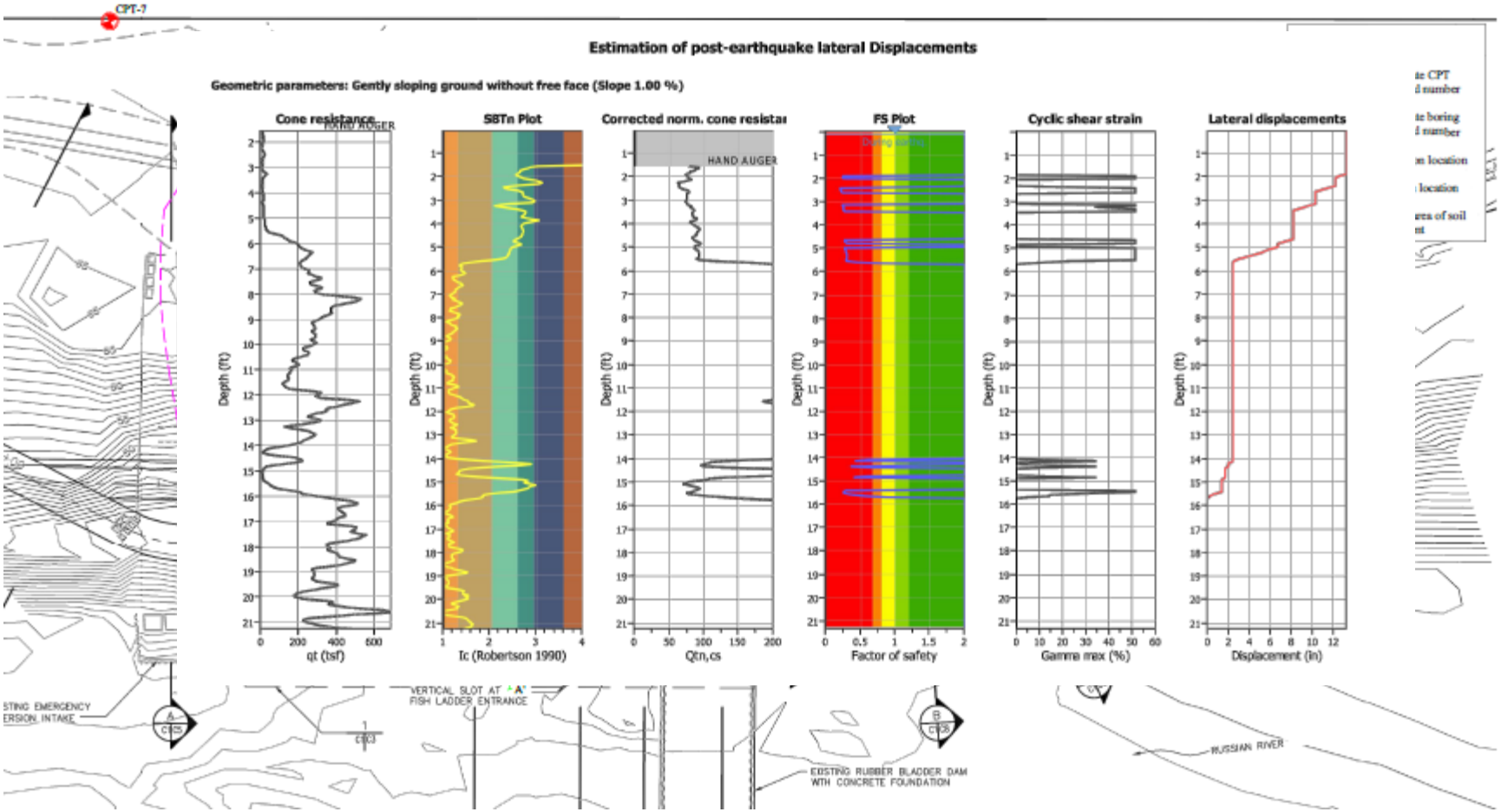
	DESIGN FEATURES INCLUDED	SCHEME 1
1	Ground Improvements for seismic and liquefaction	X
2	Fish Screen and Ladder	X
3	Drive for maintenance vehicles	X
4	Pad for code required portable restrooms	X
5	Viewing Chamber	X
6	Handicapped Ramp from top to Viewing Chamber	
7	Handicapped van parking above	
8	Handicapped van parking below	X
9	Stairway from top to Viewing Chamber	X
10	Fabric structure and viewing deck	

n

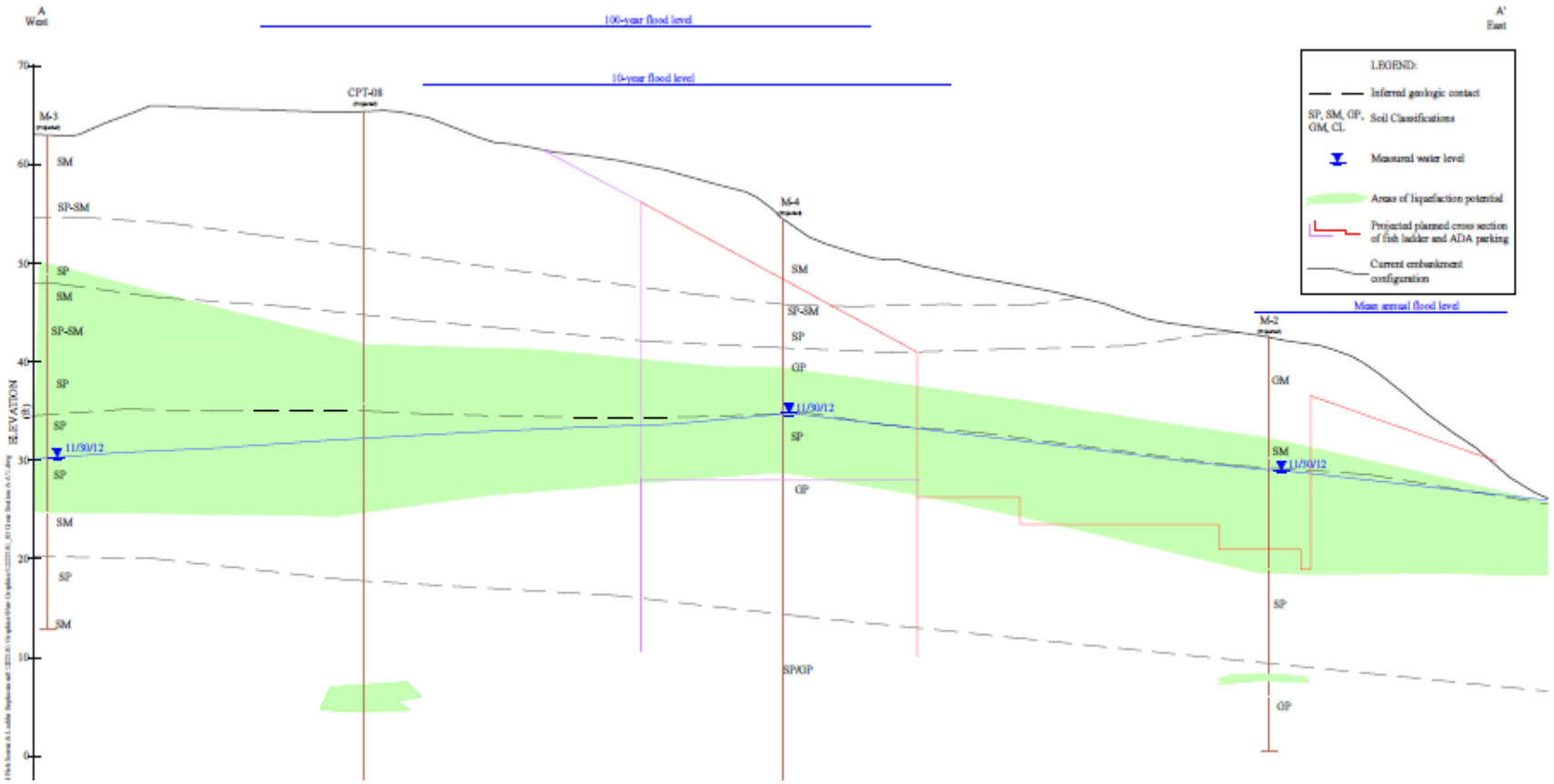


03 Geotechnical Issues

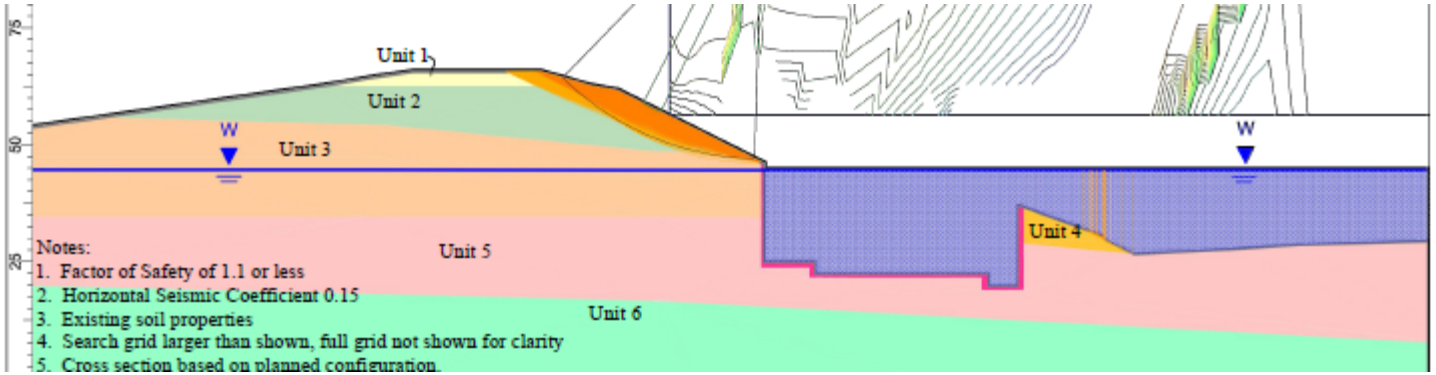
Geotechnical Investigation

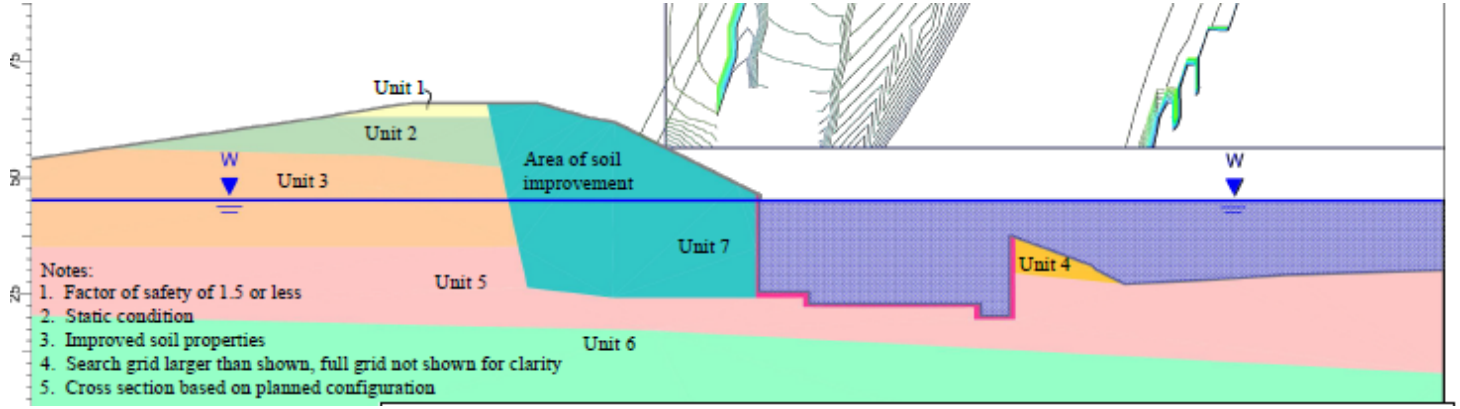


Liquefaction Potential

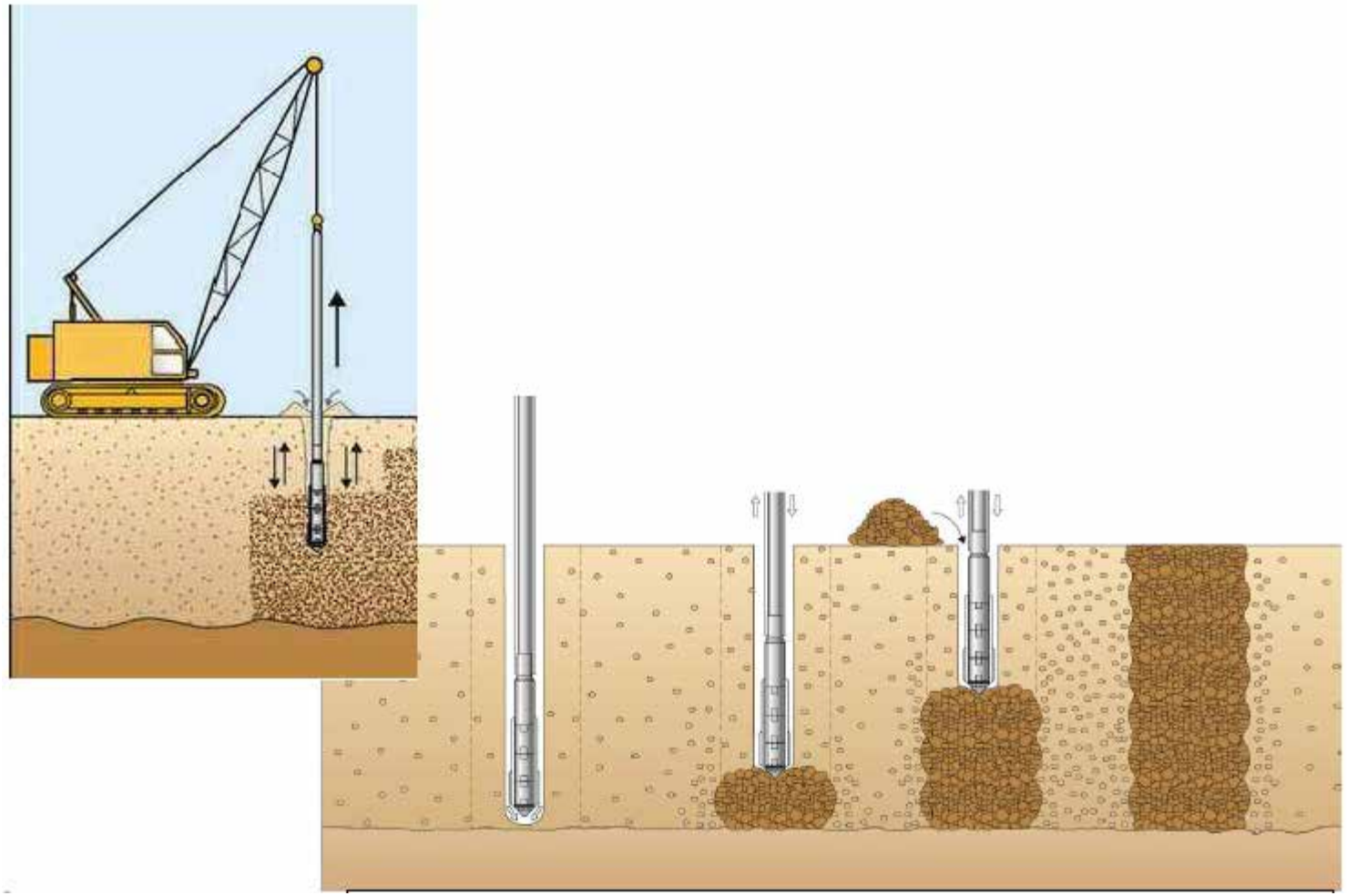


Liquefaction Potential

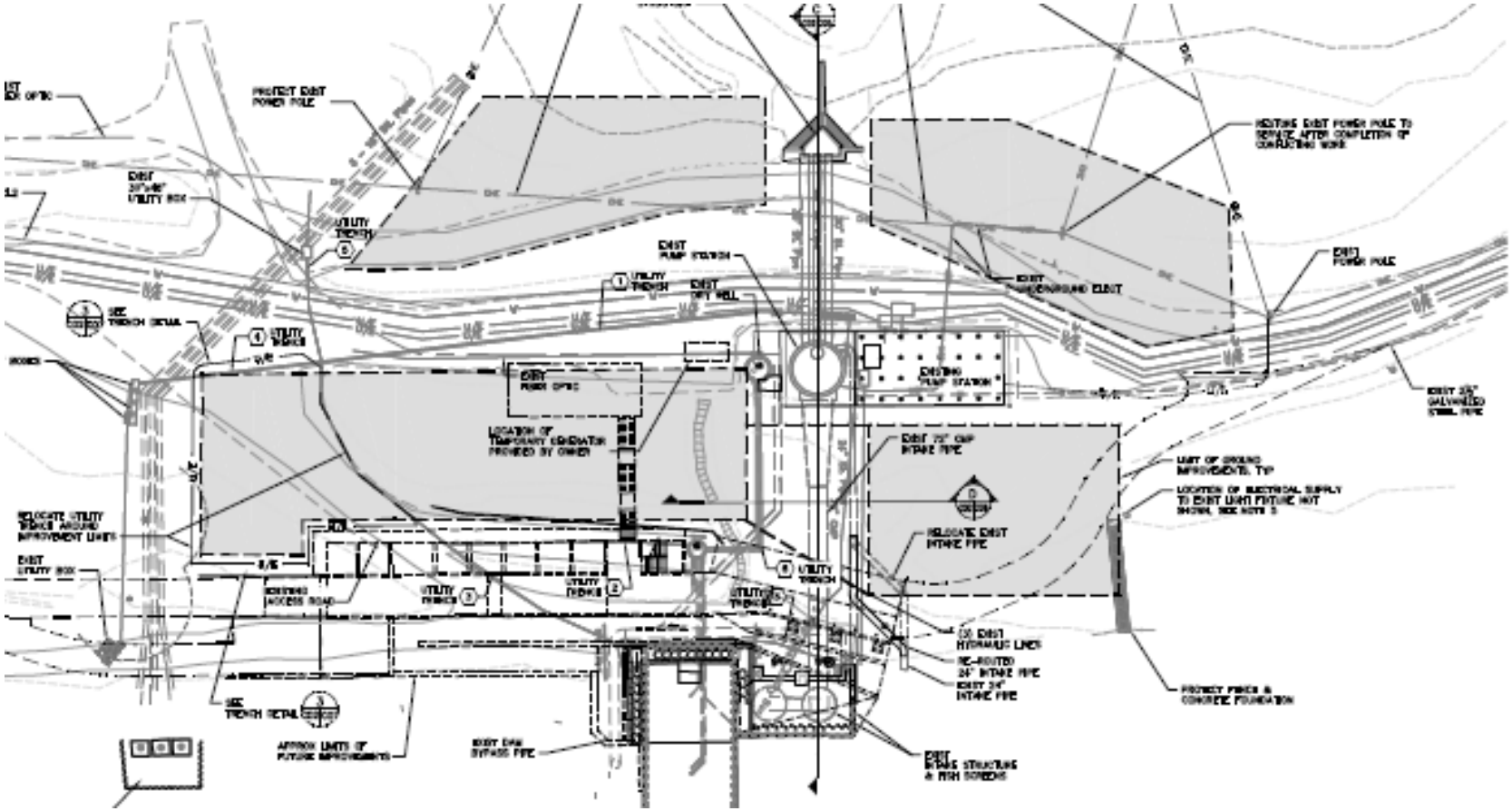




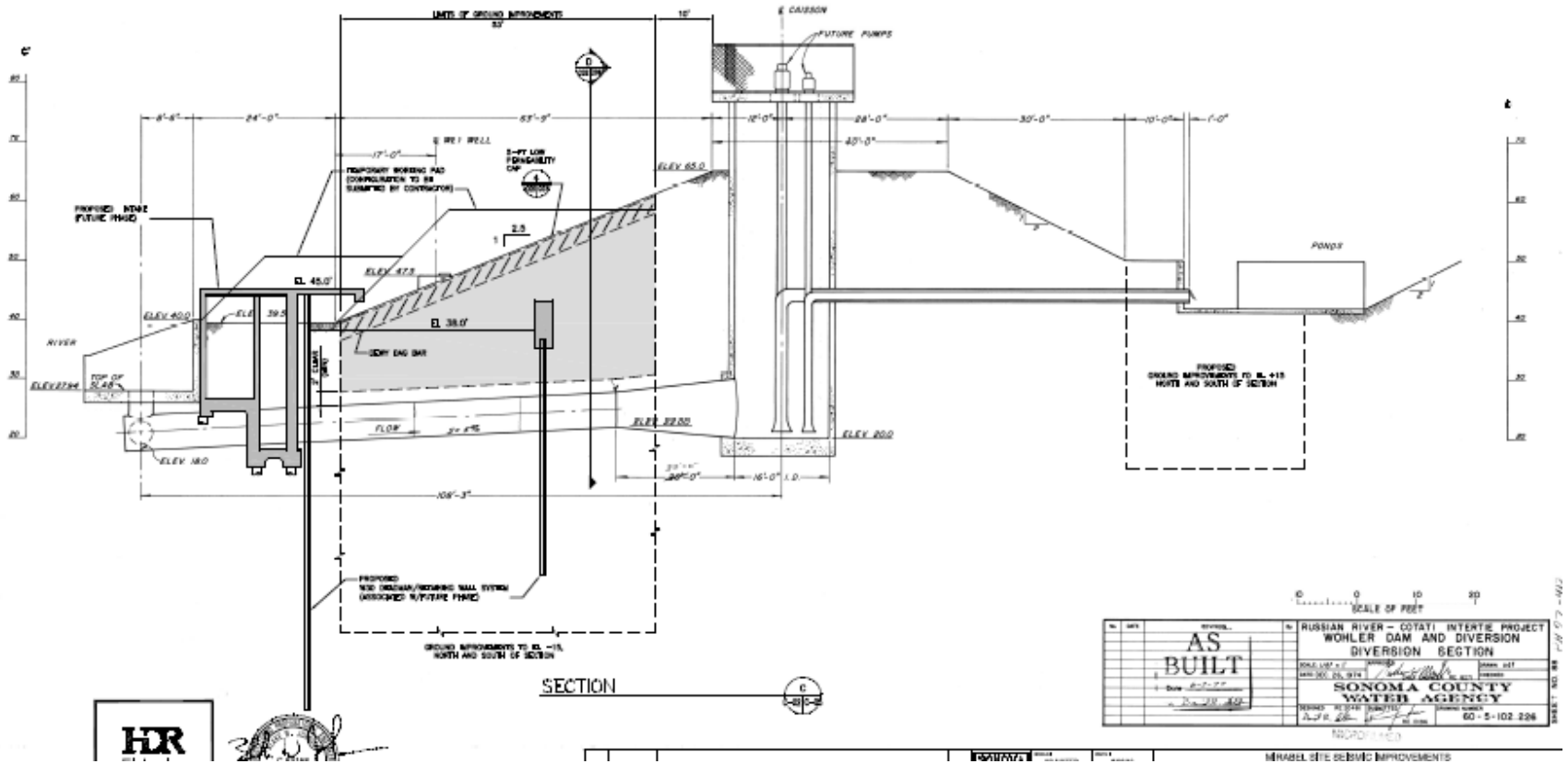
Liquefaction Mitigation – Ground Improvement



Liquefaction Mitigation – Ground Improvement

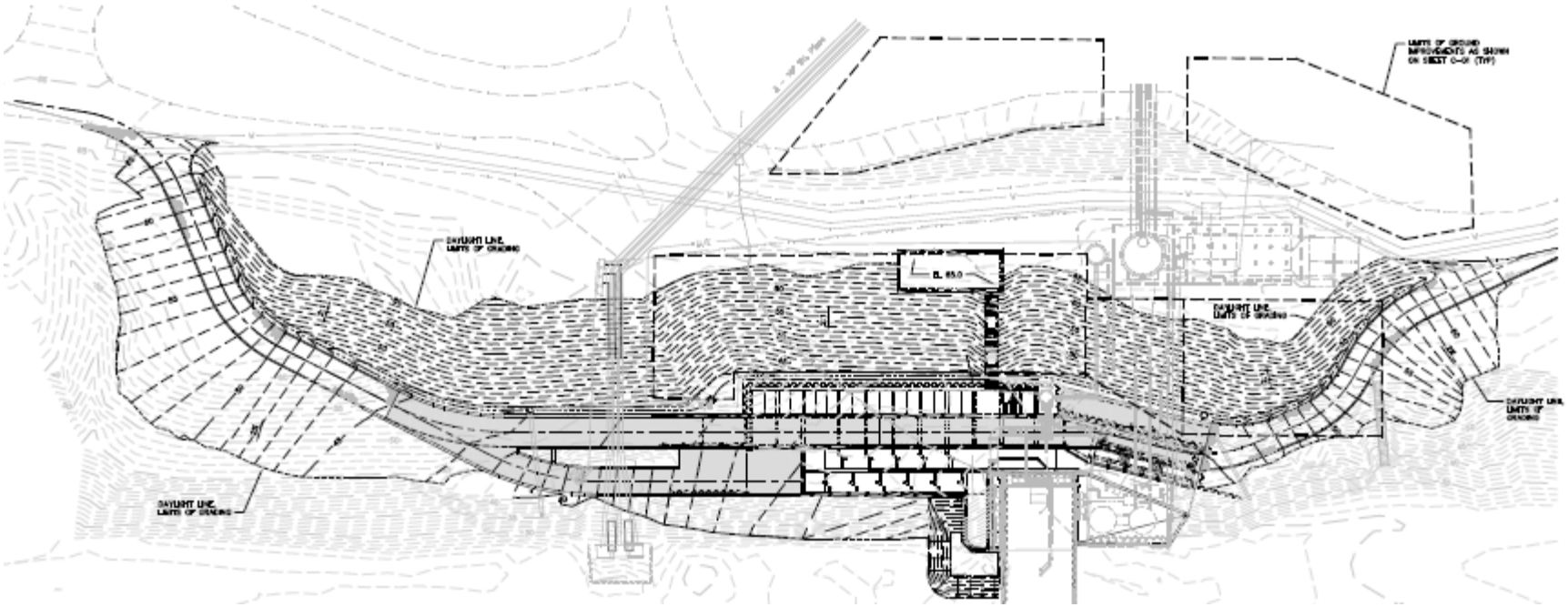


Liquefaction Mitigation – Ground Improvement

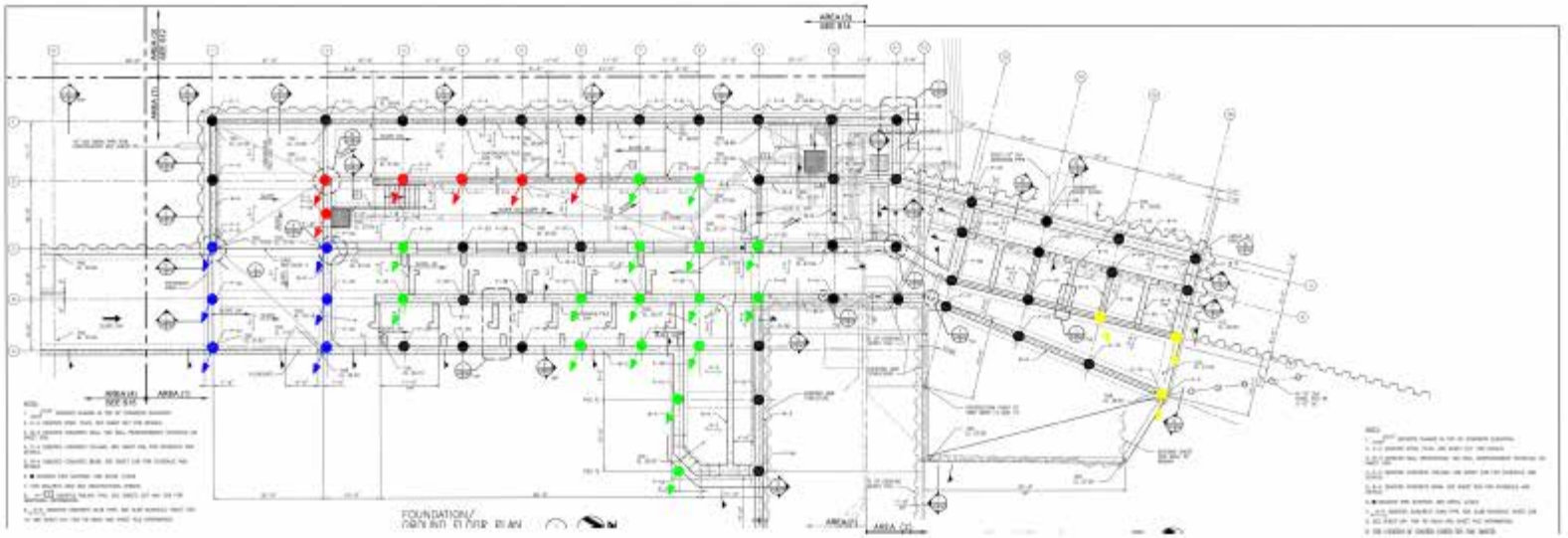


04 Final Design

Final Design



Final Design

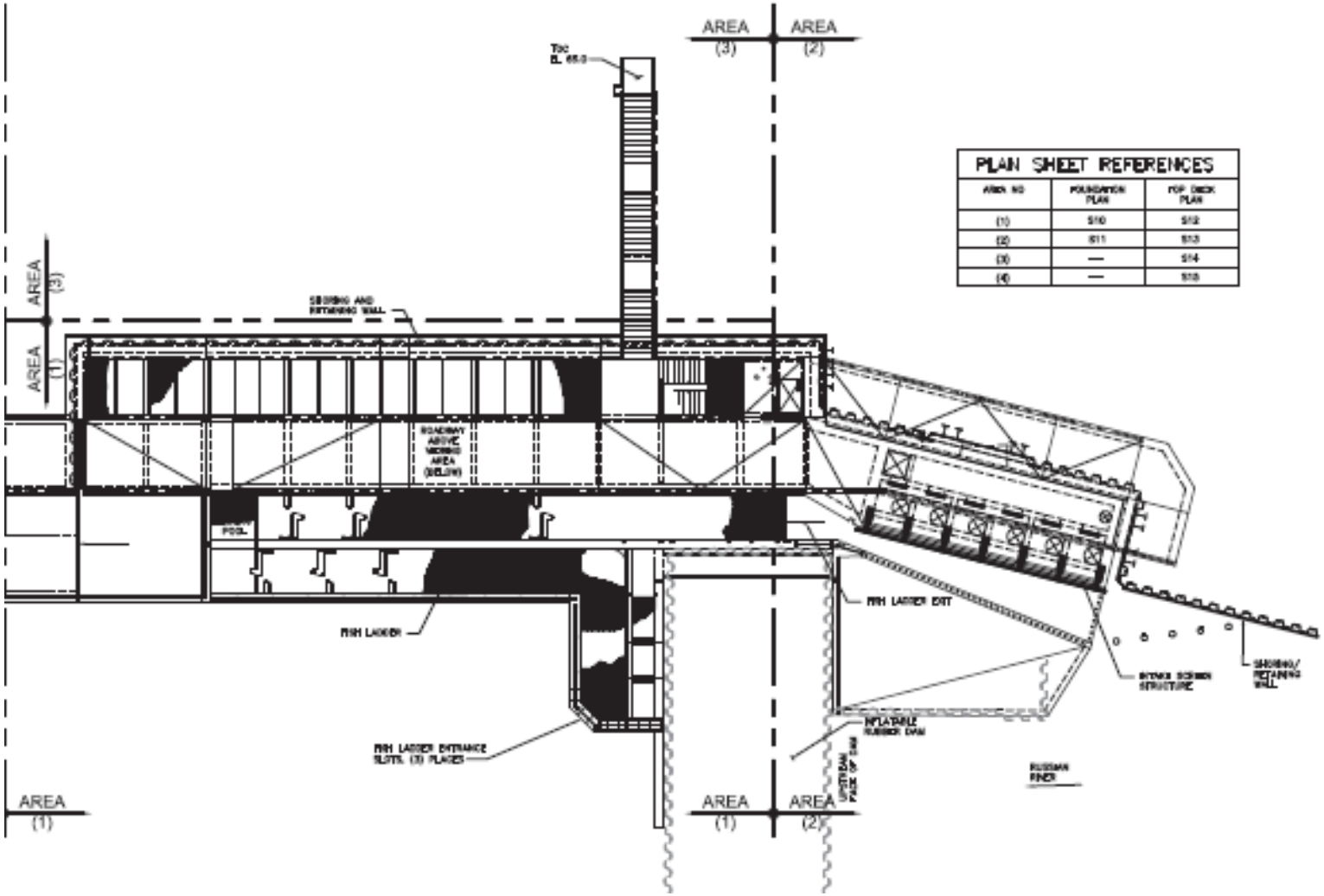


Share force applied at pile/slab connection due to potential liquefaction

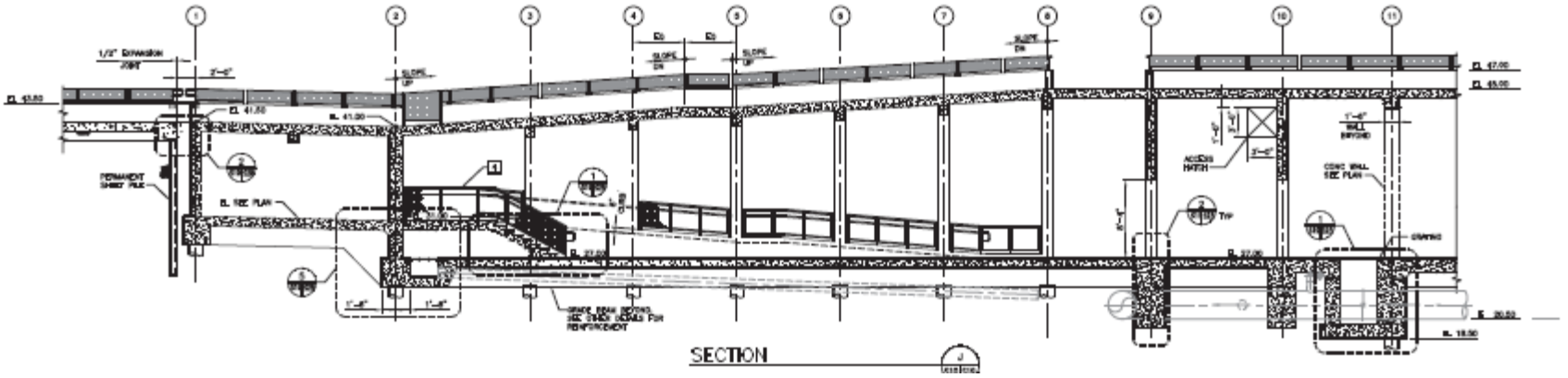
- 0 lbs
- 110 lbs
- 200 lbs
- 310 lbs
- 445 lbs
- Direction of lateral load

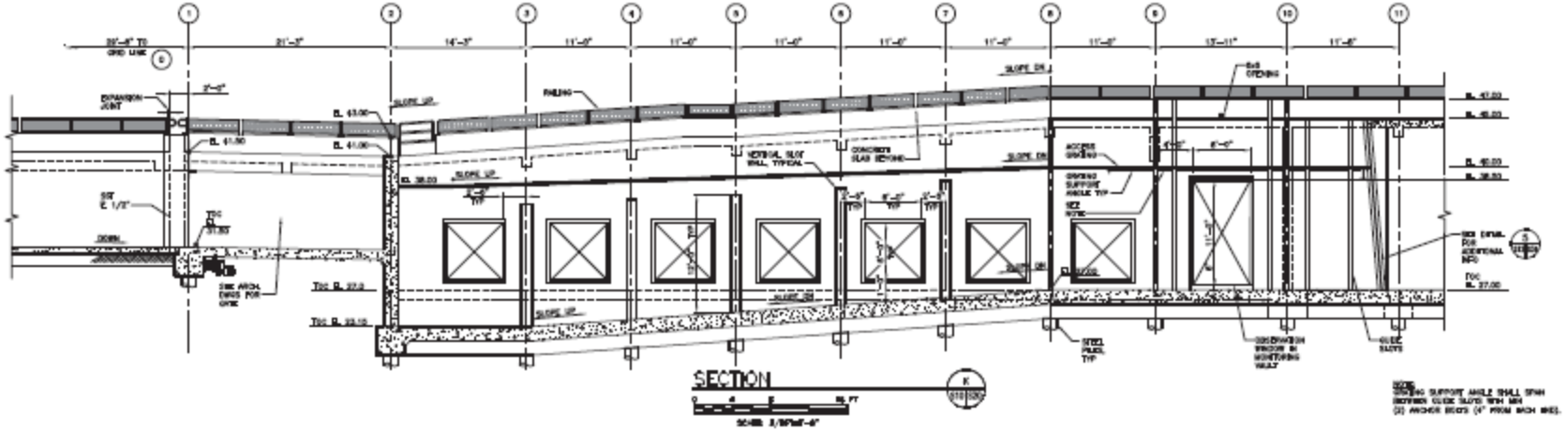
Note:
These loads are half of lateral load apply to the pile by the soil.

Final Design

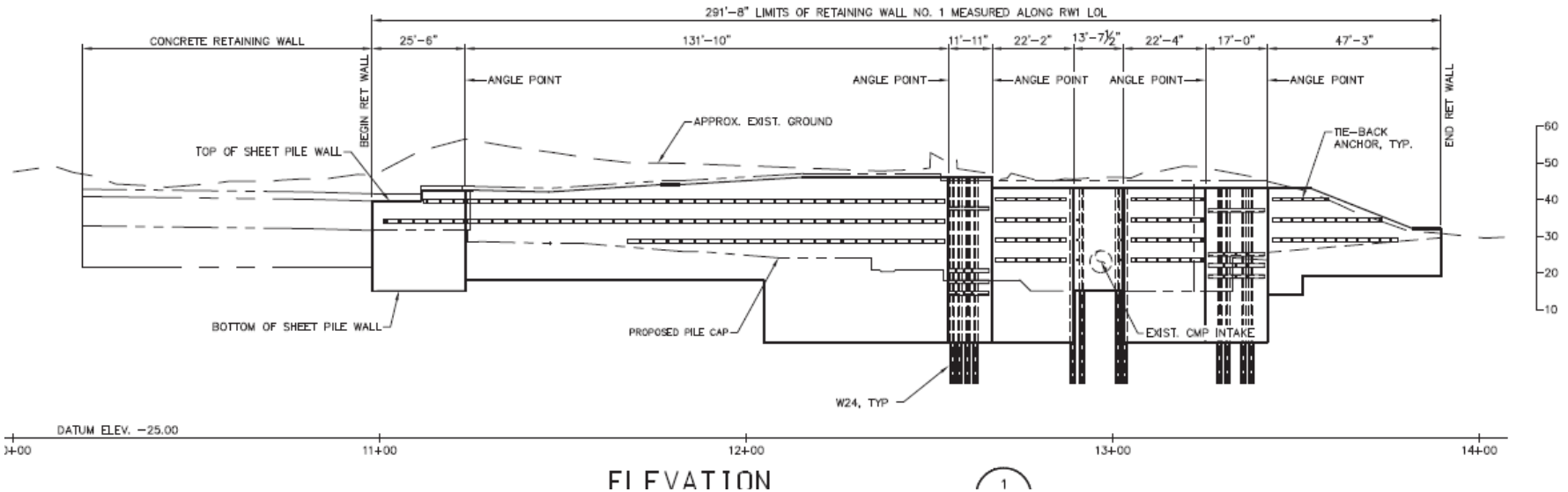


Final Design



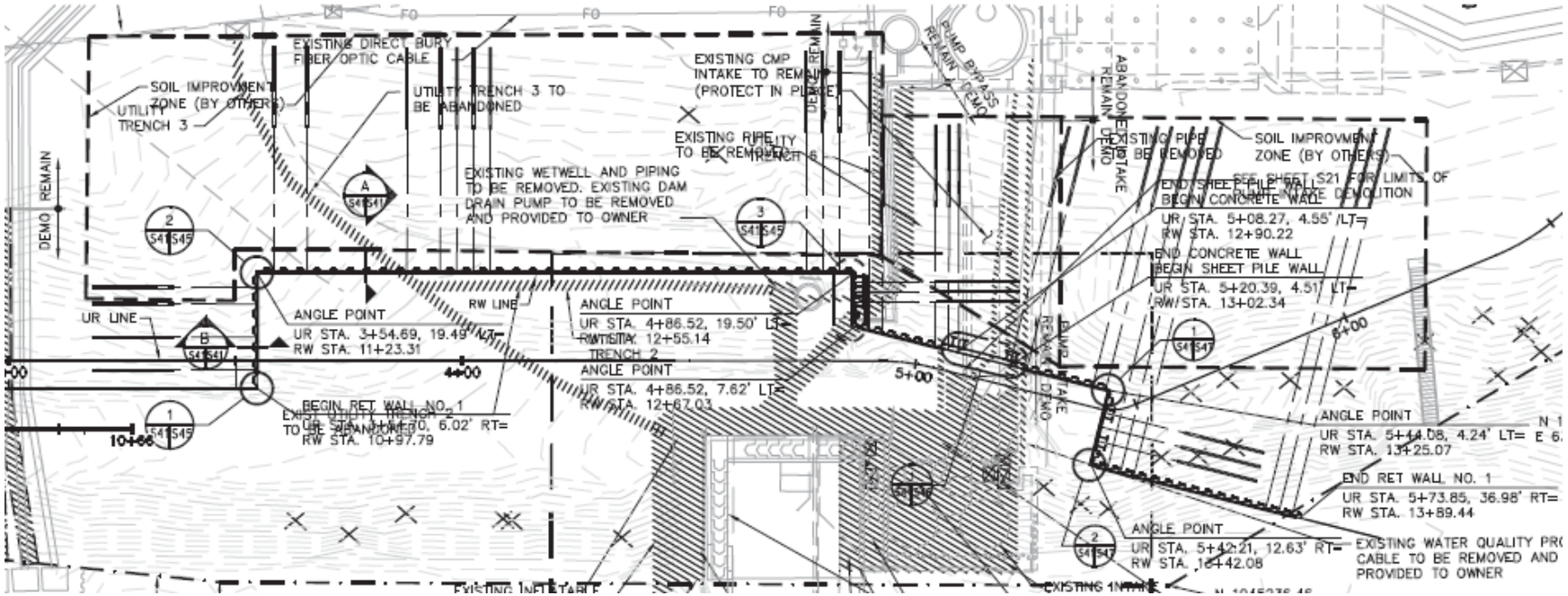


Final Design

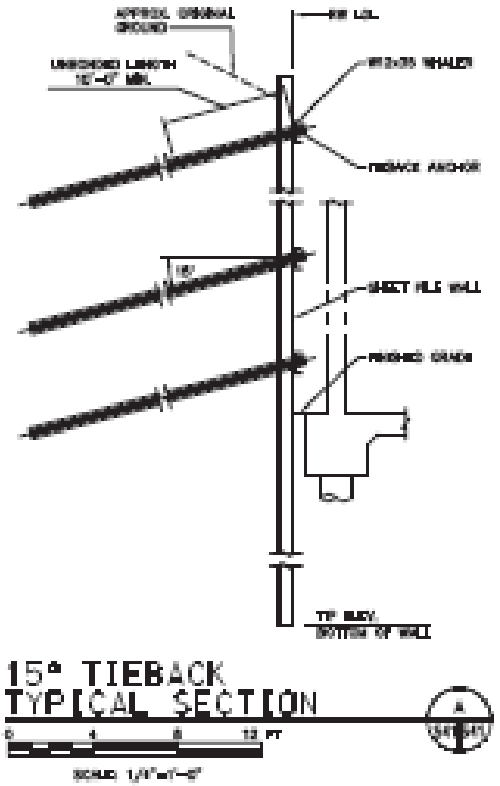


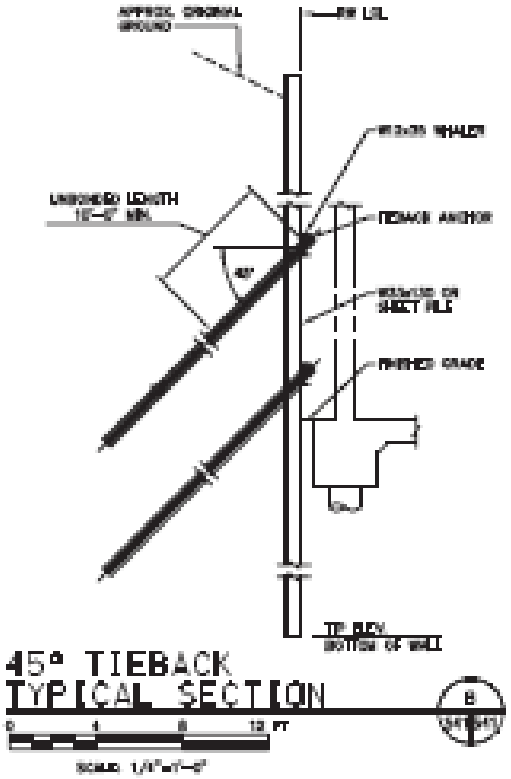
ELEVATION 1

Final Design



Final Design

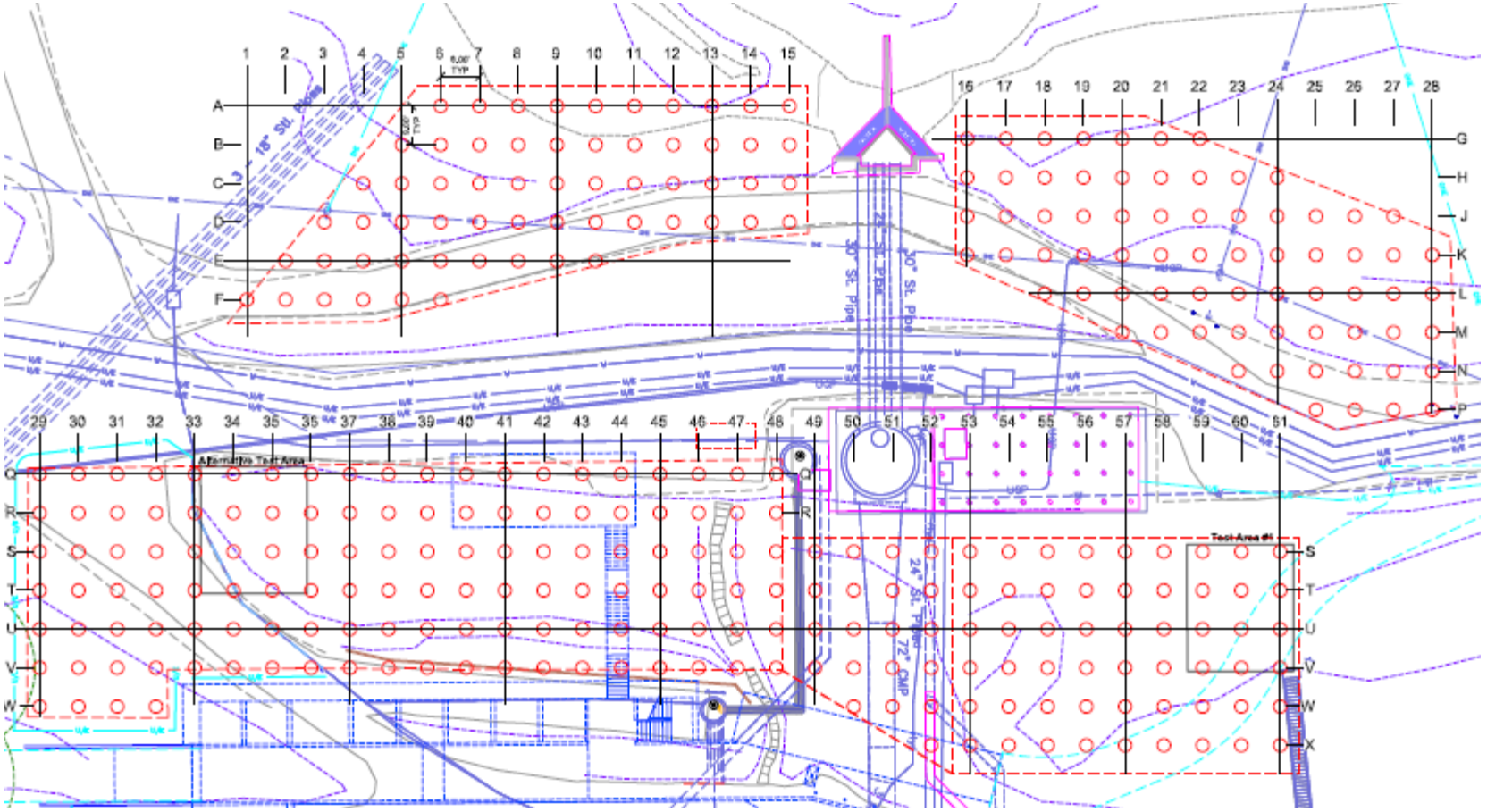




05 Ground Improvements

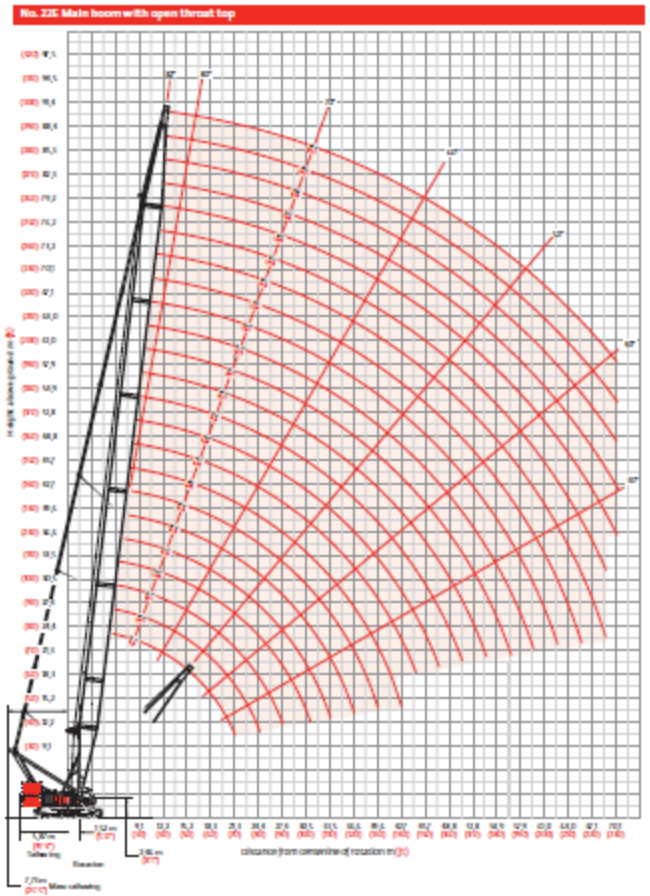
Construction begun in February

Ground Improvement Plan



Ground Improvement

Open throat top boom range diagram



Ground Improvement

Ground Improvement

Ground Improvement


ATTENTION
THIS SITE UNDER
VIDEO SURVEILLANCE
FOR INFORMATION GO TO
WWW.SONOMACOUNTYWATER.ORG
SONOMA
COUNTY
WATER
AGENCY

06 Wrap Up

Construction

- Start August
- Finish Fall 2015
- Diversion during construction
- El Nino winter?

Acknowledgement

SONOMA COUNTY WATER AGENCY

Russian River Chinook